



Review

Renminbi Internationalization Process: A Quantitative Literature Review

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Review

Renminbi Internationalization Process: A Quantitative Literature Review

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Abstract: As China's position in the global economy has gradually improved, the importance of debates on the role of the renminbi in the international monetary system has significantly increased. This paper uses bibliometric methods—Bibliometrix R-package and its web-based graphical interface Biblioshiny—applied to data imported from Web of Science and Scopus to investigate and synthesize the renminbi literature published in English between 1995 and 2021. Science mapping offers a visual representation of different networks and clusters of authors' keywords. The performance analysis, a quantitative evaluation of the most published sources, authors and papers on renminbi internationalization in the last 25 years, shows that the interest on the topic has grown, particularly after 2009 and 2016, respectively. There is also a high degree of concentration in the field, considering that out of the 802 analyzed papers, published in 393 sources, five authors and four journals had the highest impact. The content analysis identifies the main directions in the renminbi internationalization literature and future research questions to further explore this subject. The COVID-19 pandemic and post-Ukraine war era could generate a deeper reform of the international monetary system, in which the Chinese currency will strengthen its global position alongside the US dollar and the euro.

Keywords: bibliometric analysis; Bibliometrix; Biblioshiny; Chinese currency; renminbi internationalization; science mapping



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1. Introduction

Interest in reform of the international monetary system has risen in the last decade, stimulated by the global and European crises and by the system's weaknesses which have been signaled. The subject has become widely discussed among economists and policy makers. There is no consensus regarding the defining features of the future international monetary system, but a multipolar system seems to be the most agreed. In recent years the most important development involves China and the international rise of its currency, the renminbi.

The internationalization of the renminbi has progressed rapidly since 2010 and the inclusion of the renminbi in the IMF's SDR basket in 2016 has given the renminbi greater credibility in the international arena. Furthermore, the renminbi's weight in the SDR basket (10.92%) is higher than that of the Japanese yen (8.33%) and the pound sterling (8.09%).

Given the renminbi certification as an international currency, academics have again questioned the viability of the US dollar-based system. Now, questions are coming for other reasons as well: agreements within the Belt and Road Initiative (BRI), impact of the COVID-19 pandemic, intensive financial digitalization, a growing focus on central bank digital currencies (CBDC) and China's leading position in developing a digital currency.

In this context, given the progress in renminbi internationalization, it is important to examine the role of Chinese currency in the international monetary system. Understanding the debates, their evolution, and the latest contributions in the field by looking at the relevant academic voices can provide a common platform for both researchers and policy makers.

This study analyses the place of renminbi in the literature of the last 25 years, focusing on the process of renminbi internationalization. The questions that we wish to answer are: first, in what ways the renminbi internationalization is seen as a sustainable process? and second, how much progress has been made in the internationalization of the renminbi and what does this mean for the international monetary system?

Literature reviews have an important role in synthesizing the research findings, and the presence of numerous and fragmented research streams could be a challenge for scholars who try to organize and understand the existing contributions. There are several ways to conduct literature reviews (Snyder 2019): systematic literature review; semi-systematic review; and integrative review. One of the suitable approaches when the number of publications is high and there is a lack of consensus among specialists is science mapping and the use of bibliometrics, as a systematic, transparent and reproducible way to structure the existing contributions and to provide the big picture on the subject (Aria and Cuccurullo 2017).

This paper investigates and synthesizes the renminbi literature published in English in the last 25 years and shows the evolution of the research field to evidence the role of renminbi in the international monetary system. It uses a new approach to investigate the literature—bibliometric methods—Bibliometrix R-package and its web-based graphical interface Biblioshiny, applied to data imported from the Web of Science Core Collection and Scopus.

Therefore, the study is a bibliometric analysis that has made a quantitative evaluation of the word “renminbi” to assess the interest, evolution and trends, main sources, authors and papers, conceptual, intellectual, and social maps of this topic.

For a better understanding of the state of the art, the paper aims first to identify the most published authors, the most influential papers, and the most relevant journals for this topic. The second objective is to define the main research themes and directions. Through Bibliometric R-package features, the study collects data from relevant databases, performs data analysis, offers a visual representation of different networks (co-occurrence, co-citation, and collaboration) and clusters of authors’ keywords, and provides a synthetic interpretation of the results.

The value of the paper is given by the comprehensive review of the state of the art in the renminbi research and its findings. We first present the influential aspects of renminbi literature such as authors, papers, sources and countries. We identify five authors (McCauley, Eichengreen, Ma, Chey, and Cheung) and four sources (China and World Economy, Review of International Political Economy, China Economic Review, and Journal of International Money and Finance) having strong relations with the research topic. We find that China, USA, Hong Kong and Japan account for more than 50% of the published articles. Second, we provide a visual representation of the co-occurrence, co-citation and collaboration networks among the authors publishing on renminbi. Third, we identify the main directions in the renminbi internationalization literature and future research questions to further explore this subject.

The rest of the paper is structured as follows. Section 2 presents the research methodology. Section 3 provides the results of the analysis and interpretation. In the Section 4, an overview of the major milestones in the process of the renminbi internationalization and current role of renminbi in the international monetary system is provided by content analysis. Section 5 discusses the results and presents future research directions. Finally, Section 6 concludes the paper.

2. Research Methodology

We considered that a comprehensive review of the relevant literature on the renminbi topic is still lacking and decided to manage the research following four phases suggested by Snyder (2019):

Phase 1. Designing the review—by identifying the research question, search strategy (search terms, databases, inclusion and exclusion criteria, etc.) and research methodology; The keyword selection process was performed in two stages. In the first stage, in our Web of

Science Core Collection and Scopus databases' search, we have examined both "renminbi" and "yuan" and the results showed that many articles used both names. In stage two, we decided to continue by using "renminbi" as the official Chinese currency and the most frequent term in the scientific literature. As regards the timeline, we analyzed the entire period automatically generated by the searches, a full-time span from 1995–2021.

The starting point in choosing an appropriate research methodology was the paper of [Moral-Munoz et al. \(2020\)](#) which made a comparative analysis of the most important bibliometric/scientometric tools and software that has been developed, highlighting their relevant characteristics.

The bibliometric research is usually performed using descriptive statistics and basic tools, while the VOSviewer is the most frequently used software for scientometric mapping ([Merediz-Solà and Bariviera 2019](#); [Bamel et al. 2020](#); [Dwekat et al. 2020](#); [Eduardsen and Marinova 2020](#); [Marchiori et al. 2020](#); [Nasir et al. 2020](#); [Perannagari and Chakrabarti 2020](#); [Li and Xu 2022](#)).

Several articles have used the Bibliometrix and Biblioshiny to analyze the existing research on different themes such as landscape sustainability ([Zhou et al. 2019](#)), smart and sustainable cities ([Janik et al. 2020](#)), rural depopulation ([Rodríguez-Soler et al. 2020](#)) or sustainable land use ([Xie et al. 2020](#)), effect of knowledge management in social media ([Zarei and Jabbarzadeh 2019](#)), knowledge transfer ([Gu et al. 2021](#)), role of digital innovation and artificial intelligence ([Di Vaio et al. 2020, 2021](#)), China's Belt and Road Initiative ([Cao and Alon 2020](#)), financial literacy and financial behavior ([Ingale and Paluri 2020](#)) or trade credit ([Pattnaik et al. 2020](#)).

Therefore, for this study we chose the Bibliometrix R-package and its web-based graphical interface Biblioshiny that provides a more extensive set of tools for quantitative research in bibliometrics.

Phase 2. Conducting the review—by doing a pilot test of the review process with a smaller sample and setting criteria for search. We tested the search keywords and the criteria for search first, in the Web of Science Core Collection and then, we expanded and extrapolated the process using the Scopus database. In the final sample, we collected data from Web of Science Core Collection and Scopus databases, where we searched by topic (title, abstract and keywords) and we applied filters such as English language, document types (journals, books and conference proceedings) and subject area and categories.

Phase 3. Analysis—by applying specific tools to the final sample; the data are presented as descriptive information and in the form of findings and results.

Phase 4. Writing up the review.

The bibliometric analysis of the "renminbi" is based on the workflow proposed by [Aria and Cuccurullo \(2017\)](#), comprising:

- *Data Collection:*

- (a) the first step was to *collect data and export records*:

- from Clarivate Analytics—Web of Science Core Collection database in October 2021. The word "renminbi" was chosen as the topic (title, abstract and keywords), and the document type was specified as only articles written in English for the document type; the total number of documents found was 712. By refining the results within the WoS categories of Economics (379), Business Finance (163), International Relations (94), Business (46), Political Science (47), Area Studies (30), Development Studies (12) and Management (32), we reached 545 documents.
- from Scopus database in November 2021, searching for "renminbi" as title, abstract, and keywords, we found 801 documents in English. By limiting the results to Economics, Econometrics and Finance (466), Social Sciences (266), and Business, Management and Accounting (157) as subject area—we obtained 641 documents.

- (b) the second step was to load the data and convert to R data frame. A bibliographic data frame is obtained by converting function *convert2df*. It is a data matrix with cases

corresponding to manuscripts and variables with Field Tag in the original WoS and Scopus files.

- (c) the third step was to merge bibliographic data frames from WoS and Scopus into one and to clean it by deleting duplicates from the bibliographic collection. As a result, 384 duplicated documents were removed and the conversion results reached 802 records.

Therefore, the final database for analysis consists of 802 documents.

- *Data analysis*, with two stages: a descriptive study of the bibliographic dataset and a network creation for co-occurrence, co-citation, and collaboration analysis.
- *Data visualization* as: a thematic map, a word map, a historiograph and network mapping. *Bibliometrix* (2020) supported the main stages of the workflow, especially in:
 - data importing and conversion to R format;
 - bibliometric analysis of a publication dataset;
 - building matrices for co-occurrence, co-citation, collaboration, and co-word analysis.

At the same time, with *Biblioshiny* (2019), we were able to perform science mapping analysis using the main functions of the *Bibliometrix* R-package, with 7 options: overview, sources, authors, documents, conceptual structure, intellectual structure and social structure. It allowed us to obtain different types of graphs, that is uncommon in other libraries.

To complete our findings, we made a content analysis of the collected papers and identified 180 documents that analyze the Chinese currency internationalization.

3. Results

The bibliometric study of the “renminbi” focus on *the research fields* (analytics and plots on three levels—sources, authors, and documents) and *structures of knowledge* (conceptual, intellectual, and social).

In the study timespan (1995–2021), 969 authors published 802 documents (547 articles or 68.2%) in 393 sources (journals, books, conference proceedings, etc.). As measures of collaboration, we have: 350 single-authored documents, 0.828 documents/author, 1.21 authors/document, and a collaboration index (calculated as total authors of multi-authored articles/total multi-authored articles) of 1.6, reflecting a weak collaboration in publishing articles on this topic.

The relations between the authors, authors’ keywords, and sources can be viewed using the Three-fields Plot, that illustrates which concepts (as keywords) were explored and in which sources the authors had published most frequently. This is a diagram with different colors and sizes of rectangles—the more relations one element had, the higher is the rectangle representing it.

Figure 1 illustrates that there are five authors (McCauley, Eichengreen, Ma, Chey, and Cheung) and four sources (China and World Economy, Review of International Political Economy, China Economic Review and Journal of International Money and Finance) having strong relations with the main research topics (“renminbi”, “renminbi internationalization”, “rmb”, “rmb internationalization”, “Chinese renminbi”).

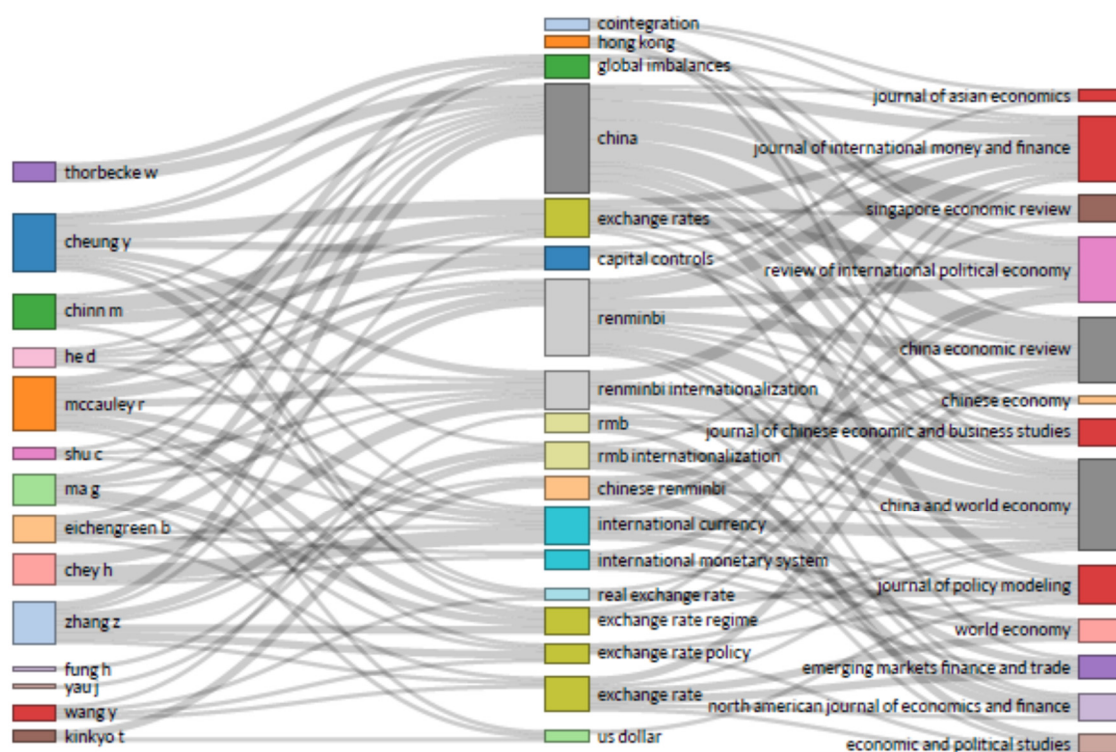


Figure 1. Three-fields plot (authors—authors' keywords—sources). Source: Authors' elaboration using Biblioshiny.

3.1. Research Field Analysis and Mapping at Three Levels—Sources, Authors, and Documents

(a) Sources

This section identifies the most relevant sources (journals, books and conference proceedings) by number of articles, the top 10 sources by source impact, and core sources using Bradford's Law from the collection of 393 sources.

Table 1 ranks the top 10 sources using different impact measures (Aria and Cuccurullo 2017): the h_index (source's number of published articles cited in other journals at least h times), g_index (h_index improvement to measure the global citation performance of a set), m_index (h_index/n , where n is number of years since the first published paper of the journal), total citations (TC), net production (NP) and production year start (PY start).

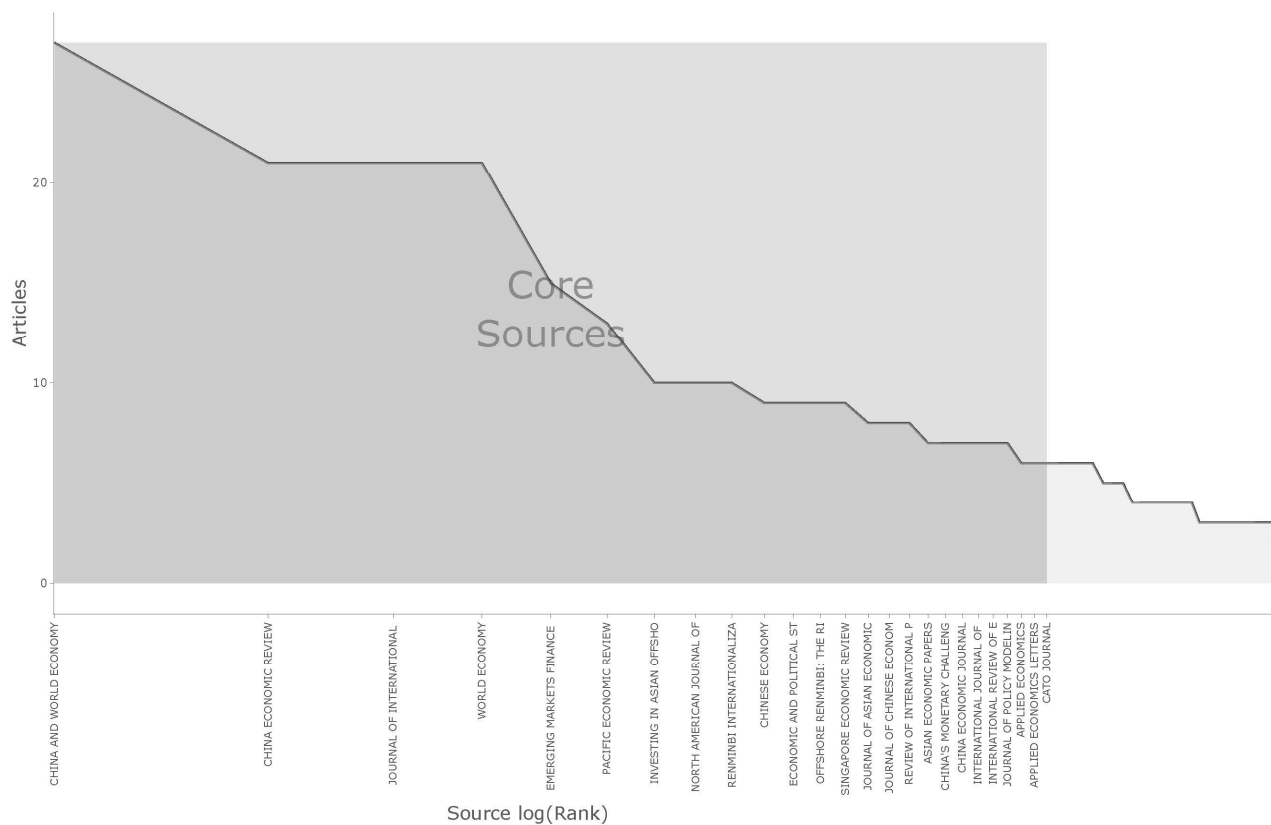
China Economic Review has the best impact indexes, ranking in the first position. It is followed by China and World Economy, Journal of International Money and Finance and World Economy.

The core sources are identified by using Bradford's Law, that states: "if the journals are arranged in descending order of the number of articles on the subject, then successive zones of periodicals containing the same number of articles on the subject form the simple geometric series $1:n_5:n^2_5:n^3_5$ " (Biblioshiny 2019).

The sources are divided into three zones according to Bradford Law (270 articles on each zone): zone 1 (nuclear) that is represented with grey and vertical gridlines in Figure 2 is highly productive and represents core sources (25 journals with 268 papers); zone 2 (middle, 104 sources) is moderately productive (270 papers); zone 3 (minor, 264 sources) has a low production (264 papers). Thus, the core sources are 25 journals from a total of 393 sources that published about 33.4% of the documents of the entire collection (802 articles). The results were obtained by including associate journals to reach 270 articles on each zone.

Table 1. Top 10 sources by source impact.

Rank	Source	h_index	g_index	m_index	TC	NP	PY Start
1.	CHINA ECONOMIC REVIEW	11	19	0.6111	365	21	2004
2.	CHINA AND WORLD ECONOMY	9	14	0.5625	230	27	2006
3.	JOURNAL OF INTERNATIONAL MONEY AND FINANCE	9	19	0.6	368	21	2007
4.	WORLD ECONOMY	8	15	0.4705	245	21	2005
5.	JOURNAL OF ASIAN ECONOMICS	7	8	0.4666	165	8	2007
6.	PACIFIC ECONOMIC REVIEW	6	12	0.3	159	13	2002
7.	EMERGING MARKETS FINANCE AND TRADE	5	9	0.41666	98	15	2010
8.	CHINESE ECONOMY	5	6	0.4545	48	9	2011
9.	REVIEW OF INTERNATIONAL POLITICAL ECONOMY	5	8	0.3125	96	8	2006
10.	RENMINBI INTERNATIONALIZATION: ACHIEVEMENTS, PROSPECTS AND CHALLENGES	4	7	0.57142	53	10	2015

**Figure 2.** Core sources by Bradford's Law. Source: Authors' elaboration using Biblioshiny.**(b) Authors**

To identify the most published authors in the field which could have a substantial impact on future research, this part presents the most relevant authors by number of documents published, top 10 authors' production over time, author impact, corresponding authors' countries, country scientific production and most cited countries.

Figure 3 indicates growing interest in Chinese currency research during and after the global crisis. The lines represent the authors' timeline—Na N. has the longest timeline,

1998–2019. The color intensity is proportional to the total citations per year and the bubble size is proportional to the number of documents. The most relevant authors are: Cheung Y., with 28 appearances and 11.75 fractionalized frequency; Zhang Z. with 18 appearances and 6.53 fractionalized frequency; McCauley R. with 17 appearances and 7.75 fractionalized frequency; Eichengreen B. with 14 appearances and 9.83 fractionalized frequency.

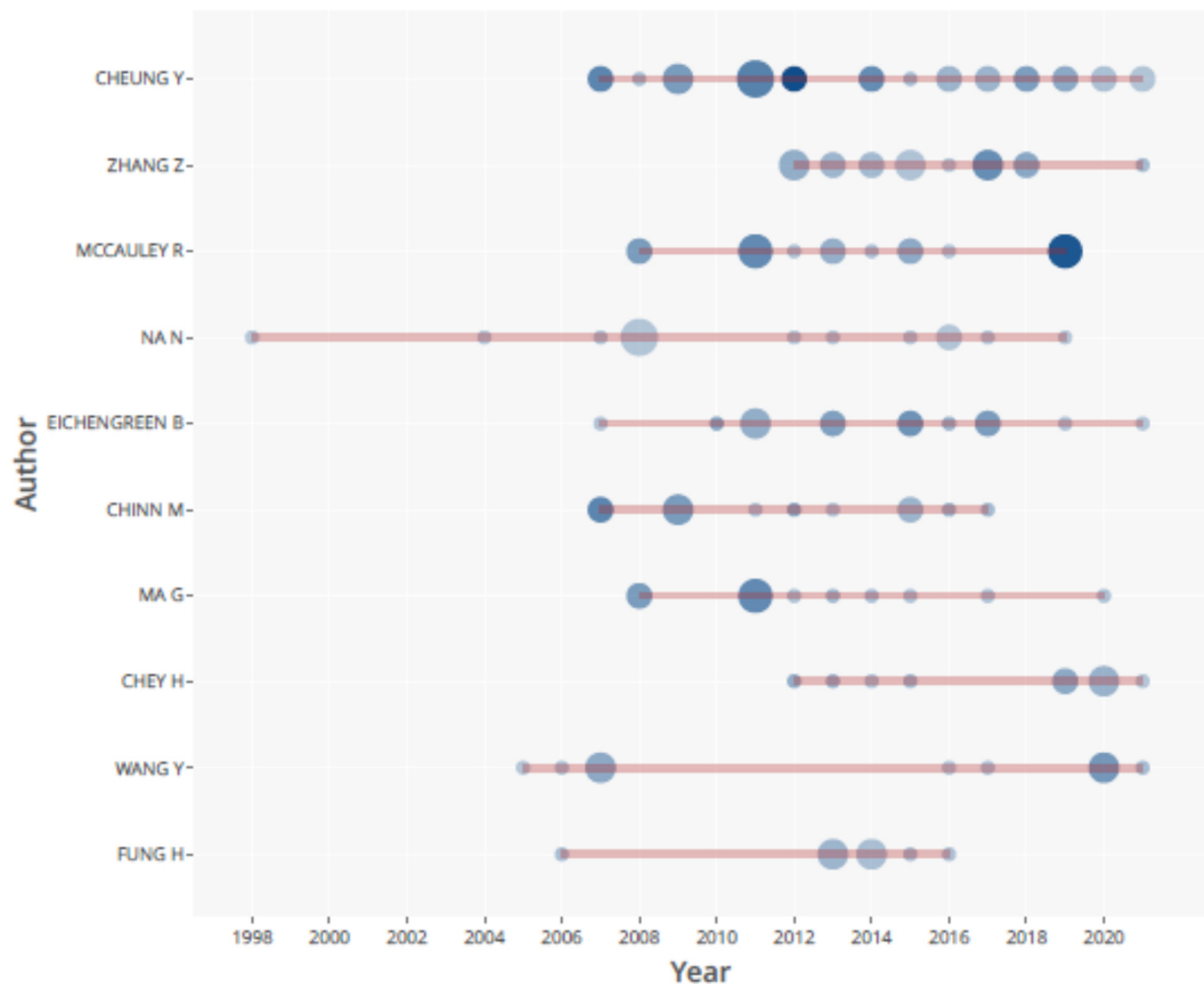


Figure 3. Top 10 authors' production over time. The bigger the circle is, the more articles have been published by the author in that year. The darker the circle is, the more citations per year have been acquired. Source: Authors' elaboration using Biblioshiny.

Table 2 ranks the top 10 authors using different impact measures—*h_index*, *g_index* (which means that the top 10 publications of an author have been cited at least 100 times), *m_index* (the *h_index* divided by the number of years that a researcher has been active), total citations (TC), and net production (NP).

China is in first place for corresponding author's country by number of documents (260 documents), scientific production (365 documents) and most cited country (1333 total citations) followed by USA, Hong Kong and Japan.

(c) Documents

For a better understanding of the state of the art in the field, this section identifies the most influential papers and frequently used words in titles and authors' keywords that could represent significant factors for the growth of the research field.

Table 3 ranks the top 10 cited papers and reveals the total citations for each document that come from documents included in the entire WoS and Scopus databases (global

citations). The citations received from documents of the analyzed collection (local citations) are lower.

Table 2. Top 10 authors by author local impact (h_index in the analyzed collection).

Rank	Author	h_index	g_index	m_index	TC	NP
1.	Cheung Y.	10	22	0.667	490	28
2.	McCauley R.	7	14	0.571	224	17
3.	Eichengreen B.	8	13	0.533	183	14
4.	Zhang Z.	6	9	0.6	96	17
5.	Chinn M.	6	12	0.4	226	12
6.	Ma G.	6	12	0.429	165	12
7.	Fung H.	5	6	0.313	40	9
8.	Thorbecke W.	5	9	0.313	178	9
9.	McKinnon R.	5	7	0.313	84	7
10.	Chey H.	4	8	0.4	68	10

Table 3. Top 10 cited papers by global citations.

Rank	Paper	Total Citations
1.	(McNally 2012), SINO-CAPITALISM: China's reemergence and the international political economy, <i>World Politics</i>	150
2.	(Zhao and Xia 2010), Research on the RMB exchange rate regime: based on Sino-US economic relationship, <i>Proceedings of 2010 International Conference on Management Science and Engineering</i>	128
3.	(Cheung et al. 2007), The overvaluation of Renminbi undervaluation, <i>Journal of International Money and Finance</i>	101
4.	(Cheung et al. 2012), China's Outward Direct Investment in Africa, <i>Review of International Economics</i>	96
5.	(Thorbecke and Smith 2010), How would an appreciation of the Renminbi and other East Asian currencies affect China's exports?, <i>Review of International Economics</i>	93
6.	(Funke and Rahn 2005), Just how undervalued is the Chinese renminbi?, <i>World Economy</i>	80
7.	(Prasad 2014), <i>The dollar trap: How the U.S. dollar tightened its grip on global finance</i> , Princeton University Press	79
8.	(Ji et al. 2019), Risk dependence of CoVaR and structural change between oil prices and exchange rates: A time-varying copula model, <i>Energy Economics</i>	73
9.	(Marquez and Schindler 2007), Exchange-rate effects on China's trade, <i>Review of International Economics</i>	72
10.	(Dobson and Masson 2009), Will the renminbi become a world currency?, <i>China Economic Review</i>	66

These papers were written during 2005–2019, when several changes in the renminbi exchange rate regime took place to make it more flexible: in July 2005 China gave up the fixed exchange rate of the renminbi; from August 2008 to June 2010, in responding to the global crisis, China re-pegged the renminbi to the US dollar; after June 2010, the IMF reclassified China's exchange rate system as a crawl-like arrangement with a fluctuation band of $\pm 2\%$; on August 2015, the People's Bank of China took a decisive step towards floating the renminbi exchange rate, changing the central parity quoting mechanism.

by renminbi with 114 occurrences (18%) and renminbi internationalization with a total of 44 occurrences (7%).



Figure 5. Top authors' keywords as a Tree Map. Source: Authors' elaboration using Biblioshiny.

The evolution of the authors' keywords use can be seen in Figure 6. As variables, it includes annual occurrences and publication year, showing the result of a Loess regression technique to analyze the growth of keywords usage overtime.

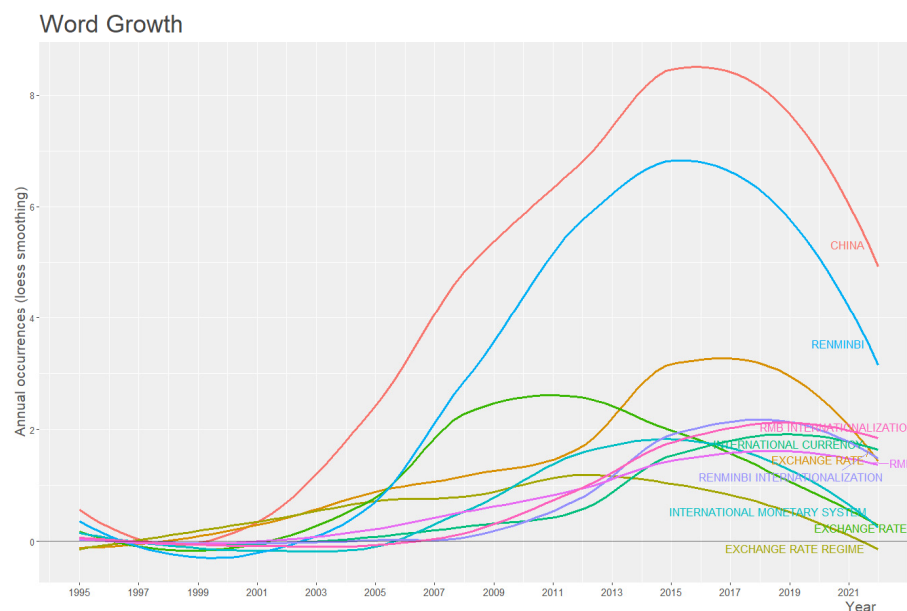


Figure 6. Word dynamics in authors' keywords in 1995–2021. Source: Authors' elaboration using Biblioshiny.

The research interest regarding the role of China has increased since 2001 considering China's economic, technological and financial evolution between 2000 and 2017. In addition, it can be justified by the Belt and Road Initiative (BRI) adopted by China in 2013.

The internationalization of the renminbi has become a subject of debate after the global financial crisis and it is widely discussed today.

3.2. Bibliometric Analysis and Science Mapping on Three Structures of Knowledge (Conceptual, Intellectual, and Social)

The renminbi bibliometric analysis and science mapping were performed on three structures:

- A. conceptual—to discover the main themes and trends in the research field;
- B. intellectual—to find how an author's article influences a scientific community;
- C. social—to see how authors, institutions, and countries interact with each other.

A. Conceptual structure

The conceptual structure of the field can be underlined using co-word analysis and mapping the research area. According to [Aria and Cuccurullo \(2017\)](#), a conceptual structure map of a scientific field can be created using different reduction techniques such as Correspondence Analysis (CA), Multiple Correspondence Analysis (MCA) or Metric Multidimensional Scaling (MDS), and clustering algorithms of a term network extracted from keywords, titles or abstract fields.

We chose the Multiple Correspondence Analysis, which is an exploratory data analysis without any restrictive assumptions for studying the interdependence among a set of categorical variables to identify new latent variables ([Cuccurullo et al. 2016](#)).

The Bibliometrix R-package allows using MCA to examine the relationship between authors' keywords and to draw a conceptual structure of the field and clustering algorithms to find clusters of papers that address the same issues.

The analysis is organized in two directions:

1. A network approach (co-word analysis) to show:
 - the co-occurrence network;
 - the thematic map;
 - the thematic evolution.

We started with a *co-occurrence matrix* using Multiple Correspondence Analysis (MCA). The authors' keywords are plotted on a two-dimensional map resulting in a network graph representing a term co-occurrence network ([Aria et al. 2020](#)). In this way, it is possible to represent the knowledge base and to explore the different themes developed in the research field.

Figure 7 reveals the co-occurrence network by selecting authors' keywords as field. The colors represent the clusters to which each word belongs—3 colors, showing that in the literature there are three trends—the first is the red cluster (centered on China), the second is the blue cluster (centered on renminbi) and the third is the green cluster (centered on renminbi internationalization).

To highlight the different themes of the research field, we applied a clustering algorithm on the authors' keywords network, where the centrality points the importance of the theme and density measures the theme evolution.

For this purpose, Figure 8 presents the *thematic map* of the literature, where each bubble is a network cluster with a size proportional to the cluster word occurrences. In the upper-right quadrant are motor themes (renminbi internationalization, Belt and Road Initiative), in the lower-right quadrant are basic themes (China, exchange rate), in the lower-left quadrant are emerging or disappearing themes (equilibrium exchange rate) and in the upper-left quadrant are niche themes (capital account liberalization, ASEAN).

Figure 9 shows the *thematic evolution*, bringing a historical perspective to the renminbi literature divided into three periods (by setting authors' keywords as field and 2 cutting points—in 2008 and in 2016—and an inclusion index weighted by word occurrence): 1995–2008 (until the global crisis)—when the exchange rate is principal; 2009–2016 (during the crisis and until the inclusion of the renminbi in the SDR)—when China and renminbi stand out; 2017–2021 (after the inclusion of the renminbi in the SDR and during the COVID-19 pandemic)—with an accent on renminbi and renminbi internationalization.

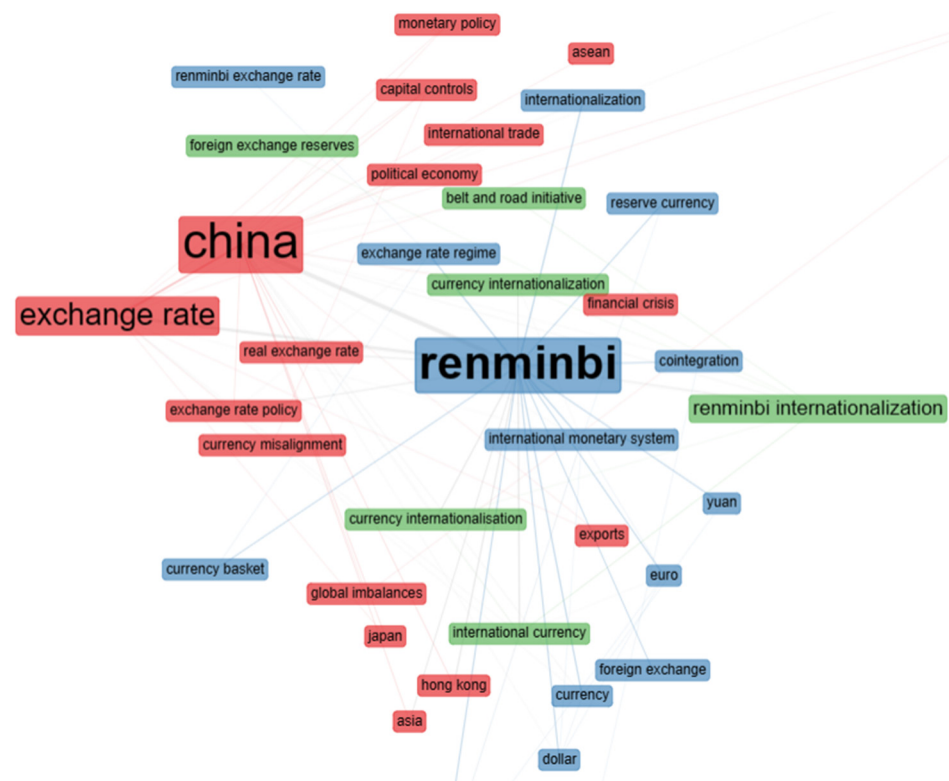


Figure 7. Co-occurrence network of authors' keywords. Source: Authors' elaboration using Biblioshiny.

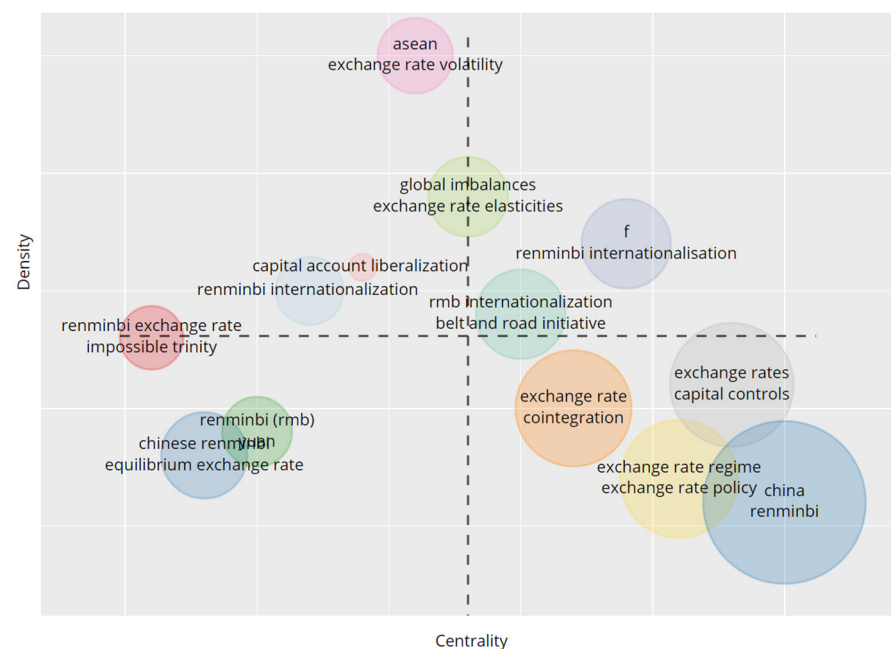


Figure 8. Thematic map of the renminbi literature. Source: Authors' elaboration using Biblioshiny.

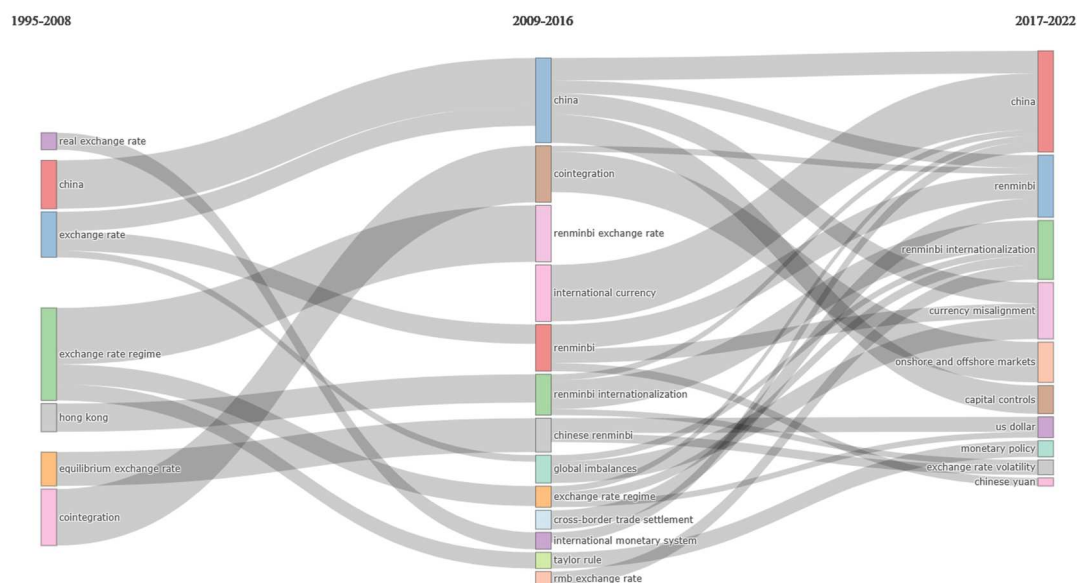


Figure 9. Thematic evolution of the renminbi literature (1995–2021). Source: Authors' elaboration using Biblioshiny.

2. A factorial approach to drawing the conceptual map.

To see subfields of the research area, we chose to draw a conceptual map of the authors' keywords, by selecting Multiple Correspondence Analysis (MCA) and 40 terms. The authors' keywords are plotted on a two-dimensional map that shows a closer representation for the words with a similar distribution (Cuccurullo et al. 2016). The result is Figure 10 where two clusters can be observed (1—red and 2—blue) as two topics—renminbi exchange rate and internationalization; international monetary system—and the authors' keywords distribution.

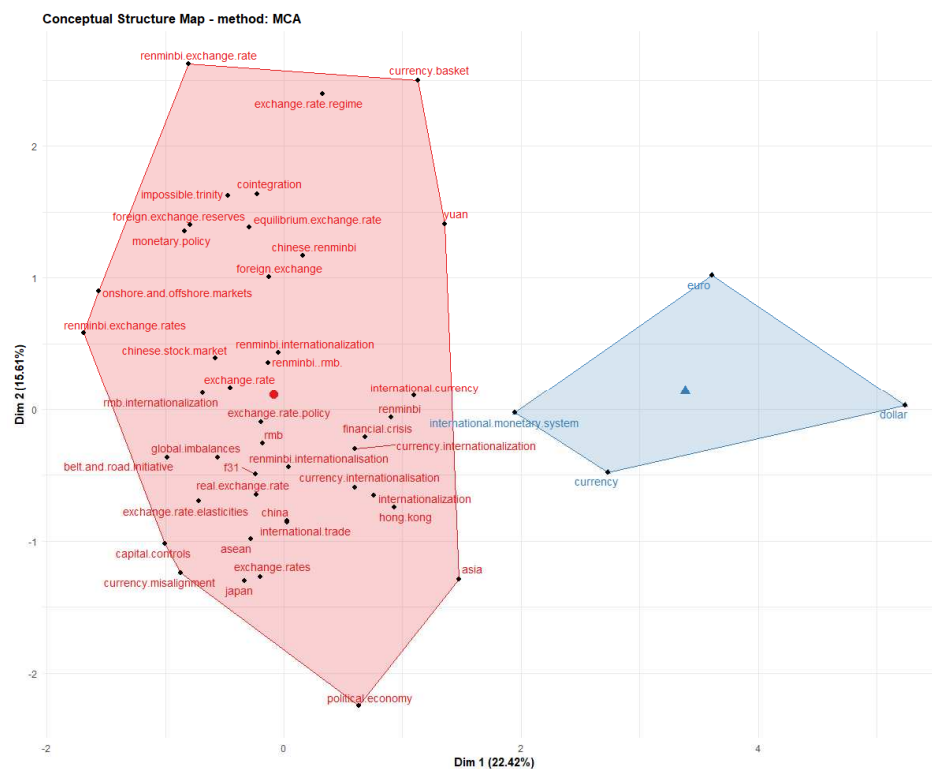


Figure 10. Conceptual map and authors' keywords clusters. Source: Authors' elaboration using Biblioshiny.

The origin of the map is the center of the research field and represents the average position of all articles. The keywords “exchange rate” and “renminbi internationalization” are closest to the center, that means that many articles cover these topics. The two dimensions of the map can be explained as follows: the horizontal dimension separates keywords reflecting economic and monetary imbalances (on the left) from those analyzing financial crisis, international currency’ determinants and renminbi internationalization (on the right); the vertical dimension separates keywords studying renminbi exchange rate and monetary policies (at the top) from those focusing on the international monetary system and the role of renminbi and US dollar in it (at the bottom).

3. Intellectual structure

The intellectual structure can be obtained using two types of analysis:

- *the co-citation network* by papers and authors (when two papers/authors are cited in/by a third document/author) and
- *the historiographic mapping*—to make a chronological map of the most relevant citations resulting from the bibliographic collection (Cuccurullo et al. 2016).

We loaded the bibliographic dataset to create a *co-citation network by papers* (Figure 11) and *by authors* (Figure 12).

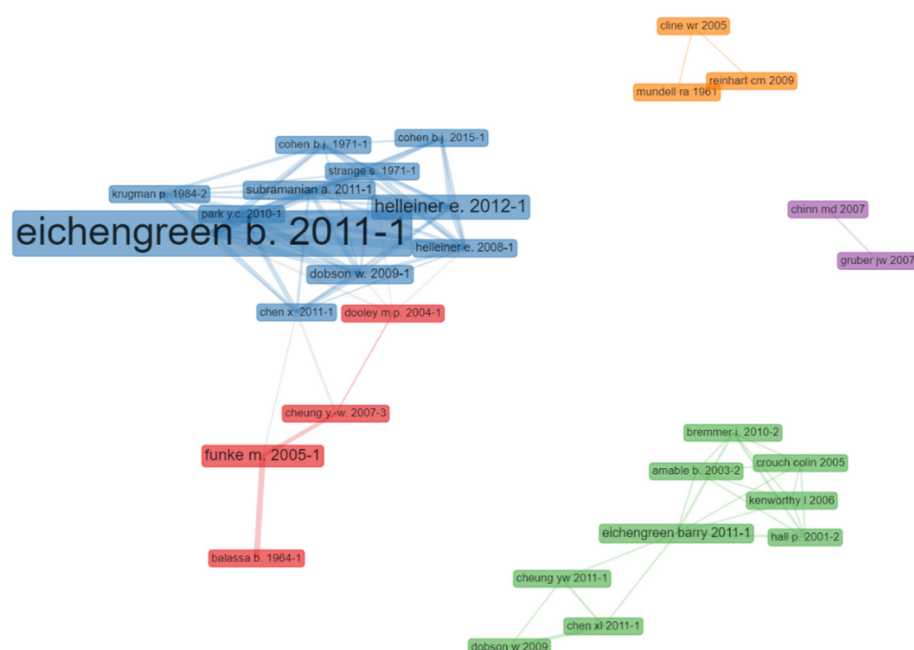


Figure 11. Co-citation network (by papers). Source: Authors’ elaboration using Biblioshiny.

In Figure 11, the center of gravity is the blue co-citation network, with papers focused on the perspective of the renminbi to become a world currency and the paper of Eichengreen (2011) as the most cited. Above the center are red and orange papers and under the center are green and violet networks.

In Figure 12, the most visible co-citation network is the blue one, between Eichengreen B., Frankel J., Prasad E., Cohen B., Chinn M. and McKinnon R.; it includes the most co-cited authors, which are well-known economists with research interests in history and evolution of the international monetary system and international currencies. The red network is formed around Zhang Z., Chen H., Wang S. and Cheung Y., researchers focused on monetary issues of Asian economies, Chinese currency exchange rate and internationalization.

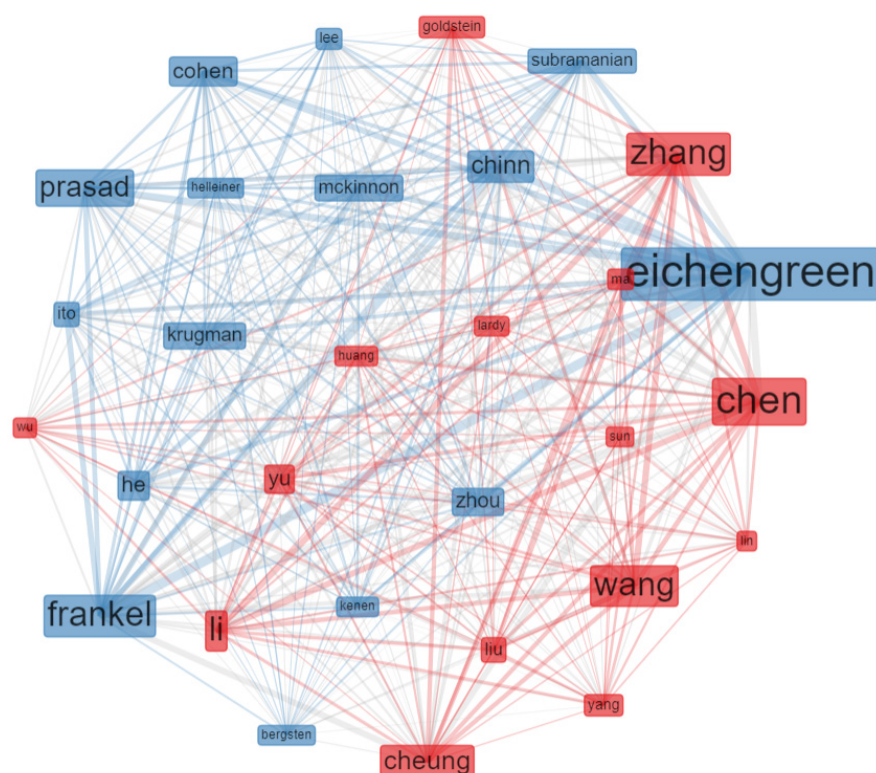


Figure 12. Co-citation network (by authors). Source: Authors' elaboration using Biblioshiny.

These two networks allow us to visualize the connections between papers or authors. In this way, it is possible to estimate the impact and influence of different papers and authors in this field.

We then made a *historiograph* (a historical direct citation network) of the most relevant citations of the analyzed collection to identify new research topics and core authors/documents. The network is drawn by selecting 50 nodes, but as can be seen in Figure 13 only 14 nodes are represented, that are the papers directly cited by other documents since 2008. We can refer to 4 research paths that start with: Funke and Gronwald (2008)—renminbi/US dollar exchange rate evolution; Cheung et al. (2009)—exchange rate misalignment; Bénassy-Quéré et al. (2010)—equilibrium exchange rate; McNally (2012)—China international role.

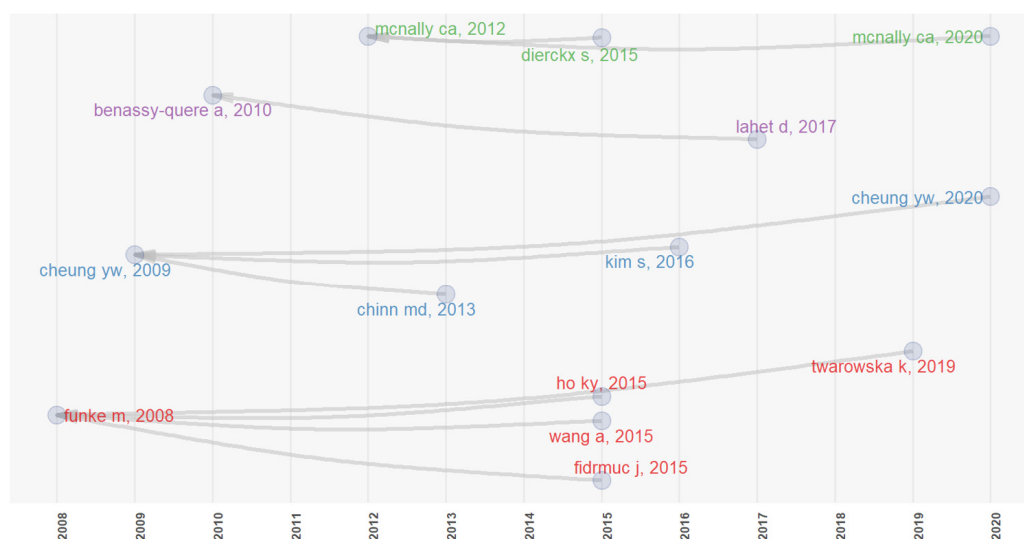


Figure 13. Historiograph (by paper). Source: Authors' elaboration using Biblioshiny.

In our dataset, the average number of global citation scores (GCS) is 6.1 with a standard deviation of 12.6 and a median of 2, indicating that 95% of the values are less than 19.1 and 1% of the values are more than 31.7.

B. Social structure

The social structure can be represented through the collaboration networks in this research field between authors, institutions and countries.

We created the *authors' collaboration network* by selecting the parameters: 50 nodes (one node for each author), 2 minimum edges (edges indicate co-authorship relationships), Kamada and Kawai network layout, Walktrap Clustering algorithm and association normalization (the peak similarities are normalized using association strength). In Figure 14, the blue (Cheung Y., McCauley R., Ma G., Chinn M.), brown (Zhang Z., Zhang C., Li H.) and orange clusters show the most influential and significant authors' collaboration networks, while the size of a node indicates the number of publications. The other clusters with two authors suggest a weaker collaboration.

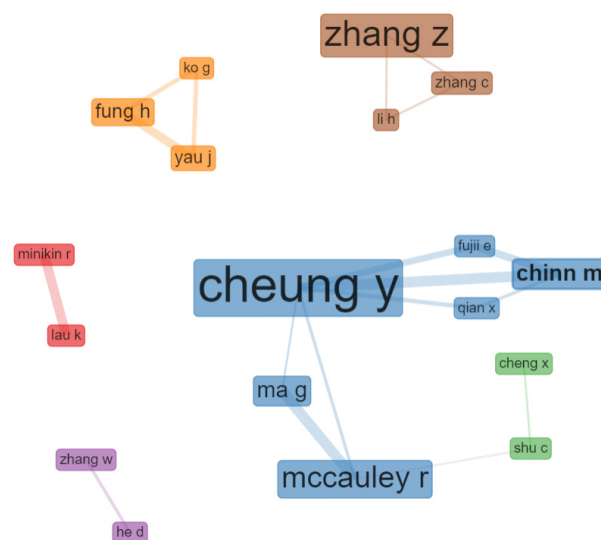


Figure 14. Authors' collaboration network. Source: Authors' elaboration using Biblioshiny.

The collaboration networks are built based on joint publications, describing the degree of cooperation between authors or groups of authors from different institutions (University of California, City University of Hong Kong, University of Wisconsin) and countries (China, USA, Hong Kong, Japan, Australia).

Summing up, the bibliometric analysis that we have made reflects that the *renminbi internationalization is seen as a sustainable process* in post global financial crisis literature—a symbol of China's rise and a common ideal of China increasing the role of its currency in the global monetary system—which help us answer the first research question.

4. Renminbi Internationalization Process—Major Milestones

To complete our findings, we made a content analysis of the collected papers and identified 180 documents that analyze Chinese currency internationalization. Two reviewers selected the articles by reading full-text papers.

Since World War II, the US dollar was the key currency of the international monetary system, as the principal means of payment, unit of account, or store of value. On the other hand, the euro has remained a regional currency more than twenty years after its introduction. As regarding the renminbi, since the mid-1990s, China has taken significant steps towards a progressive internationalization. The renminbi's relevance has been rising globally, particularly since the mid-2010s, and the inclusion in the SDR basket in 2016 makes it an official reserve currency.

In recent years, the US dollar's influence has eroded while that of renminbi started to increase, even beyond Asia. Many authors have noted these developments.

[Fratzscher and Mehl \(2011\)](#) found that the rise of the renminbi may lead to shifts in major currencies' influence in the region and that other regions' currencies may respond to shocks in China's exchange rate policy. [Subramanian \(2011\)](#) demonstrated that renminbi has become the dominant reference currency in the period 2010–2012 in 7 out of 10 East Asian currencies. They thought that a more global renminbi bloc could emerge by the mid-2030s and asked for reforms of China's financial and external sectors. [Prasad and Ye \(2012\)](#) showed that the renminbi was already on the path to ascendance as a global currency. [Lo \(2013\)](#) identified some structural shifts behind the three major global currencies 'G3'—US dollar, euro, and Japanese yen—that determined the rise of the renminbi: the weakening of the US dollar global influence; the uncertainty of the euro; the structural decline of the Japanese yen. In 2014, the European Central Bank ([ECB 2014](#)) looked at the developments in the international use of renminbi, the economic determinants of these evolutionary trends, and the prospects going forward. [Shu et al. \(2015\)](#) considered that the renminbi's influence, particularly in Asia, arises from China's significant trade ties with the region and rest of the world. [Eichengreen and Lombardi \(2015\)](#) admitted two answers to the question if the renminbi will play an international role—one accepts the role of the renminbi as a global currency and the other that the renminbi will play a regional role in Asia. [Prasad \(2016\)](#) registered the developments related to the greater international use of the renminbi.

A wide literature addresses the effects of renminbi internationalization, focusing on different components of this process: effects on the global monetary system and implications for the US dollar ([Prasad and Ye 2012](#)); effects on the euro-dollar exchange rate ([Benassy-Quere and Forouheshfar 2013](#)); effects on the stability of the international monetary system ([Bénassy-Quéré and Forouheshfar 2015](#)).

Moreover, [Chen and Peng \(2010\)](#) present empirical evidence indicating that the renminbi has become an important force on the exchange rates of the Asian currencies. Using a reserve currency model and counter-factual simulations, they estimated that the renminbi's potential as a reserve currency would be comparable to that of the Japanese yen and the pound sterling. [Yu \(2012\)](#) shows possible benefits of renminbi internationalization for China: decreasing exchange rate risks; reducing China's transaction costs in trade; improving the funding efficiency of Chinese financial institutions; expansion of the China's financial services sector. [Eichengreen and Kawai \(2015\)](#) analyze the implications of renminbi internationalization not just for China but for other countries, for the geography of international financial business and centers and for the structure of the international monetary and financial system. In their book, [Overholt et al. \(2016\)](#) look at what the renminbi era could mean for the global monetary system and the international business environment, highlighting the opportunities more than threats. Analyzing the exchange rate policy in China after 2010, [Wang \(2017\)](#) argues that a flexible exchange rate was the feasible choice in the context of renminbi internationalization.

There are authors that highlight significant challenges and required reforms in the process of renminbi internationalization.

The main challenge is financial market development. [Dobson and Masson \(2009\)](#) focused on changes in China's financial system needed before emergence of the renminbi as an important world currency. [Ito \(2011\)](#) advised China to deregulate and liberalize the capital flows and trading of the renminbi and to carefully liberalize the financial market. In an attempt to answer whether and when the Chinese renminbi will eclipse the US dollar, [Subramanian \(2011\)](#) marked the necessity for China of opening its financial system to create a deep and liquid market. Investigating the determinants of currency choice for trade invoicing, [Ito and Chinn \(2013\)](#) indicated that financial development or financial openness is among the keys for the renminbi to challenge the US dollar. [Eichengreen \(2016\)](#) underlined the need for stability and liquidity of the Chinese financial markets.

Reform of the political and legal systems is widely discussed. [Eichengreen and Flan-dreau \(2010\)](#) showed that policy support is essential, citing the Federal Reserve System's

role as the market maker for the US dollar's overtaking of pound sterling as the leading international currency. [Eichengreen \(2013\)](#) presented China's political system as an obstacle to renminbi internationalization, suggesting its substantial reform. In the same direction, [Prasad \(2016\)](#) said that a broader set of political, legal, and institutional reforms is required for the renminbi to become a safe haven currency.

The renminbi's status as an important reserve currency has been studied since the beginning of the global crisis. [Roubini \(2009\)](#) suggested that the renminbi could replace the US dollar as a global reserve currency. [Subramanian \(2011\)](#) analyzed fundamental determinants of China's reserve currency status—the size of the economy, the size of its trade, and the strength of the external financial position, looking back over the previous 110 years. He suggested that the renminbi could become the principal reserve currency within the next 10 to 15 years. [Forrest et al. \(2018\)](#) focused on what China should do to make its renminbi a successful reserve currency of the world. [Prasad \(2016\)](#) has used the following criteria to prospect the renminbi role as a reserve currency: economic size; macroeconomic policies; open capital account; flexible exchange rate; financial market development. He concluded then that renminbi was already on the path to being a reserve currency both in principle and in practice. After 3 years, [Prasad \(2019\)](#) remarked that the euro has stumbled, renminbi has stalled, and US dollar supremacy remains unchallenged. During the COVID-19 pandemic, an IMF empirical study ([Iancu 2020](#)) suggested that the US dollar's dominance as a reserve currency is expected to endure, for several reasons including rising geopolitical tensions and technological advances, particularly the emergence of digital currencies and advances in payment systems.

On the opposite side are the authors who assign the renminbi a primarily regional role as a reserve currency ([Chinn 2012](#)) or who consider that renminbi is unlikely to emerge as a top reserve currency in the next few years ([McDowell and Steinberg 2017](#)).

Data shows China's economic and financial rise in the last decade. Since 2010, China has grown and become the world's second largest economy (9.1% in 2010 and 18.7% in 2021 share of global GDP). With a population of 1.418 billion people in 2021, China is the largest economic entity in the world (18.5% of the total population) ([IMF 2021b](#)). At the same time, in 2010, China's voting share in the IMF increased from 3.8% to 6.1%, making China the Fund's third largest member after the US and Japan. In this context, it is therefore natural to wonder what the evolution of the renminbi will be and if the Chinese currency will become a major international currency.

An indicator of the international use of a currency as a medium of exchange at the private level is the degree to which it is used for cross-border payments. Despite China growing weight in the global economy, renminbi's use remains weak. In 2018, China's share was 14.57% in world exports and 9.07% in world imports ([WB 2020](#)), while the renminbi's share in international payments is low. According to European Central Bank ([ECB 2015](#)), it rose from 0.8% in October 2013 to about 2% in January 2015, moving from 12th to 5th rank (behind the US dollar, euro, pound sterling and Japanese yen). In November 2021, the 'RMB Tracker' ([SWIFT 2021](#)) showed that the renminbi has retained its position as the fifth most active currency for global payments by value, with a share of 1.85%.

A similar picture is observed on renminbi use at the public level, as a reserve currency. [Balz \(2018\)](#) estimated that in 2017 renminbi comprised only 1.7% of global foreign exchange reserves, because of concerns surrounding financial stability in China and capital restrictions. The respondents to a survey of 79 central bank reserve managers expected renminbi to account for 10–20% of their portfolios by 2020 ([ECB 2018](#)). In the last few years, the Chinese currency has appeared in the reserve portfolios of some emerging market central banks and, more recently, in the reserves of a few developed economies in Europe—for example, in June 2017, the ECB added China's currency to its international reserves (0.7% of reserve portfolio); in January 2018, the Bundesbank decided to include the renminbi in its foreign exchange reserves. According to IMF COFER data ([IMF 2021a](#)), in the third quarter of 2021 the ratio of allocated reserves held in renminbi has risen to 2.66% from 2.01% in the first quarter of 2020. Changes in reserve holdings at global level could be affected by

the COVID-19 pandemic and by the strength of China's economic partnership with BRI countries, the emergence of digital currencies and digitalization of the payment systems.

With important but still modest shares, the renminbi ranks fifth as an international payment currency and as a reserve currency.

Promoting the international use of the renminbi has been part of China's national strategy for well over a decade, to facilitate its trade and reduce the dependence on the US dollar.

Since 2010, the internationalization of the renminbi has expanded rapidly. The International Monetary Institute (IMI) of Renmin University in China compiled the RMB internationalization index (RII) that appeared in the first Renminbi Internationalization Report in 2012. By the end of 2020, the RMB internationalization index reached 5.02, a sharp increase of 54.2% year-on-year (IME 2021). Starting from 2015, the People's Bank of China published annual reports on the renminbi internationalization that contain data on the performance of its use as an international currency (PBC 2020).

The setting up of the Shanghai Pilot Free Trade Zone and the introduction of the Belt and Road Initiative (BRI) in 2013 represented important steps in renminbi internationalization. Experts at Chatham House and the Chinese Academy of Social Sciences have studied how these initiatives will impact the use of the renminbi in the economies of Belt and Road host countries and in the London offshore financial market (ChathamHouse 2017).

Another internationalization initiative is the Cross-Border Interbank Payment System (CIPS), a clearing and settlement services system launched in 2015 for the participants in cross-border renminbi payments and trade. Up to now, CIPS has a total of 53 direct participants and 1137 indirect participants (876 in Asia, 153 in Europe, 42 in Africa, 26 in North America, 23 in Oceania, 17 in South America) and in 2020 reported a total traffic of RMB 45.3 trillion (CIPS 2021). It plays a significant role in facilitating the use of the renminbi globally.

Analyzing central bank digital currencies (CBDC), Chorzempa (2021) shows that emerging markets such as China are more likely to perceive benefits by issuing a digital currency, compared to high income economies. China's digital currency comes as the next major milestone in renminbi internationalization that could support the internationalization process in the context of the Belt and Road Initiative (Duggal 2021). Esward (2020) says that the renminbi will 'rise but not rule', in other words the renminbi's role as an international payments' currency will rise if the government continues to reform the country's financial markets and remove restrictions on capital flows. Others see the digital yuan as China's most effective attack on US hegemony in the international monetary system (Rajesh and Somya 2021).

For supporting the renminbi's international role, we further mention other facts:

- China has a widely distributed foreign trade and financial transactions network;
- China's capital account has become increasingly open de facto, but de jure there are restrictions on capital inflows and outflows, most of them quantity-based;
- China has increased the flexibility of the renminbi exchange rate, although the central bank still intervenes in foreign exchange markets to keep it stable;
- China became Asia's largest stock market from 2015;
- the largest four banks in the world by assets are Chinese: Industrial & Commercial Bank of China, China Construction Bank, Bank of China, and Agricultural Bank of China;
- the People's Bank of China has a network of swap lines with about 40 central banks that extend across the globe, far beyond Asia;
- in China, the volume of cashless payments increased from 19.63 billion USD in 2012 to 340.97 billion USD in 2020, according to BIS statistics. China has the largest bank card network in the world with 8.95 billion cards in 2020 (97.3% of total cashless payments) compared to 2.07 billion cards in 2009;

- China is currently piloting the central bank digital yuan in major cities and banks, government, two major digital payment platforms (Alipay and WeChat Pay) and more than 3000 companies.

As we observed, the renminbi plays a role, even if still minor, in global trade and finance. Since 2010, through the measures it has taken, China has increased the role of its currency in the global monetary system.

To answer to the second research question, the main milestones of the renminbi internationalization process are:

- setting up of the Shanghai Pilot Free Trade Zone and introduction of the Belt and Road Initiative in 2013;
- launching the Cross-Border Interbank Payment System (CIPS) in 2015;
- developing China's digital currency in the context of the BRI and COVID-19 pandemic.

The COVID-19 pandemic has accelerated the payments digitalization process while China is leading in developing the CBDC. A digital yuan, however, has the potential to create an opportunity for increasing international use of the renminbi. In the last three decades, China has emerged as a major player in the global economy, and it could be one of the major players in the new global monetary architecture post pandemic.

5. Discussions and Future Research Directions

In recent years, there is an increased interest in the role of China's currency in the international monetary system. To see if this is reflected in the scientific literature, we undertook a bibliometric analysis of publications on "renminbi", using Bibliometrix R-package and Biblioshiny and science mapping workflow for data imported from Web of Science Core Collection and Scopus.

We investigated the interest, evolution, and trends of scientific publications on the subject, main sources, authors and papers, conceptual, intellectual, and social maps of this topic in the period 1995–2021.

The paper focused on two research objectives: to conduct a performance analysis to identify the most published sources, authors, and papers on renminbi internationalization in the last 25 years; to use science mapping for visualizing the main research themes and relevant directions and stages.

The relevance of the sources (journals or publications) for a specific topic could be measured by the number of articles published and by the impact of the articles. To present the most relevant publications, we used a chart to show the number of articles per source and, also, we identified the core sources using Bradford's Law. The results are convergent, showing that four journals—China and World Economy, China Economic Review, World Economy, and Journal of International Money and Finance—are the most relevant for the topic. Additionally, we could conclude that in the last 25 years, a journal could be considered as highly relevant for this specific topic, if it reached at least 7 articles on renminbi internationalization. As the top authors' production over time emphasized, there was a significant increase in the number of published papers after the global crisis, meaning that the last 15 years are more significant. The analysis of the sources' impact based on 4 dimensions (h-index, g-index, m-index, and total citations) provided similar results, as the four most relevant publications are the same.

The authors' contribution analysis identified influential scholars, such as Cheung Y., who co-authored 28 papers (more than 11 articles, counting fractionalized contributions), and accumulated over 490 citations or long-term interest, and Na N., who published 15 papers during the last 20 years on this topic. We noticed that China and the USA (as corresponding author's countries of origin) led the debate, and if we add Hong Kong and Japan, Asia has the geographical concentration for more than 50% of the published articles.

Keywords and titles were used to perform the thematic analyses. The increased interest in renminbi internationalization was triggered by both increasing focus on China's role in the global economy, and the challenges of international monetary system in the context of

the global financial crisis. Different tools (counting the number of citations, specific words in titles, measuring frequency as a graphical parameter) provided similar results.

Regarding the second objective, the paper uses the three pillars framework of [Cuccurullo et al. \(2016\)](#), analyzing the social, intellectual and conceptual structure of the field.

The conceptual structure reveals the co-occurrence network of authors' keywords that identify three major trends centered on China, renminbi, and renminbi internationalization. The thematic map shows that China and exchange rate are basic themes, while renminbi internationalization and Belt and Road Initiative are among motor themes. The thematic evolution brings a historical perspective on the renminbi literature divided into three periods: 1995–2008 (until the global crisis)—when the exchange rate is principal; 2009–2016 (during the crisis and until the inclusion of the renminbi in the SDR)—when China and renminbi stand out; 2017–2021 (after the inclusion of the renminbi in the SDR and during the COVID-19 pandemic)—with the accent on renminbi and renminbi internationalization.

The intellectual structure shows that the most evident co-citation network is generated by papers focused on the perspective of the renminbi becoming a world currency. As regarding new research topics, the historiograph indicates 4 significant research paths: renminbi/US dollar exchange rate evolution; renminbi exchange rate misalignment; equilibrium exchange rate; and China's international role.

The social structure presents the collaboration network in this research field by authors, institutions and countries.

One of the most synthetic views of our findings is provided in a Three-fields Plot representation. We found that there are five authors (McCauley, Eichengreen, Ma, Chey, and Cheung) and four sources (China and World Economy, Review of International Political Economy, China Economic Review, and Journal of International Money and Finance) having strong relations with the main research topics.

From the content analysis, we identified the main directions in the renminbi internationalization literature: the effects of renminbi internationalization on the global monetary system and implications for the US dollar and the euro; the challenges and required reforms in the process of renminbi internationalization; the renminbi's international role.

Both the bibliometric and content analysis play a crucial role in finding the gaps in the literature and future research questions ([Ahmed et al. 2022](#); [Alshater et al. 2022](#); [Khan et al. 2022](#); [Paltrinieri et al. 2019](#)). Thus, we considered some directions for future research:

- to extend the study considering China's digital currency plans;
- to make similar analysis for other international currencies (US dollar, euro, yen, etc.).

6. Conclusions

To sum up, the quantitative and qualitative analysis of the literature on renminbi internationalization (papers published between 1995 and 2021) shows an increasing interest in the topic as a response to major challenges and changes of the global economy in the last twenty years. The bibliometric approach is recognized as a systematic and transparent way to organize and present previous research, and the results could be important for researchers but also for policy makers.

This study contributes to the literature by offering a review of the papers related to Chinese currency and a synthesis of the main directions in the renminbi internationalization research.

- The limitations of the paper are related to dataset cleaning. For a deeper analysis, it is necessary to narrow the research, by cleaning data more accurately.

The bibliometric and content analysis reflects that the renminbi internationalization is seen as a sustainable process in post global financial crisis literature—a symbol of China's rise and of a widely shared ideal for China to increase the role of its currency in the global monetary system.

The images of the literature presented here indicate that crisis is the main incentive for reforms in the international monetary system. If the global financial crisis of 2008 has

induced the growth of China's role in international monetary governance and the increased internationalization of the renminbi, the COVID-19 pandemic and post-Ukraine war era could generate a deeper reform of the international monetary system, in which the Chinese currency will strengthen its global position alongside the US dollar and the euro. The use of digital currency, however, has the potential to create an opportunity for increasing international use of the renminbi.

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